NOTES ON CRYPTOPORUS VOLVATUS

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(WITH PLATE 159 AND 1 TEXT FIGURE)

Crytoporus volvatus is unique among polypores, for the pore-bearing layer is hidden by a volva. It is thus often termed the "hidden-pore fungus" or the "volvate polypore." During the fall of 1911, the writer frequently found this species on fallen coniferous trunks. Since that time, many specimens of it have been collected. They were growing from such hosts as Douglas fir (*Pseudotsuga taxifolia*), the western hemlock (*Tsuga heterophylla*), and white fir (*Abies grandis*). During the months of March and April, 1912, I had the opportunity of observing quite thoroughly the development of the sporophores of this fungus, and a few words might be said here to supplement what Peck (3) has already said concerning some advanced stages of the pileus. Two trees of *Tsuga heterophylla* found on the campus at the University of Washington were thoroughly infected. This gave splendid opportunity to observe the sporophores in different stages.

The very young stages of the sporophores of *Cryptoporus* are globose and covered with a thick crust of reddish-brown resin exuded from the tree. As the button grows, this crust becomes thinner and thus the sporophore appears to grow lighter in color. Because of this coating of resin, no satisfactory method of killing and embedding for histological work was found. However, some free-hand sections were made and examined after staining with eosin. In the earlier stages the button is an undifferentiated mass of fungous filaments. The cortex is soft-fleshy, hygrophanous, and white. Soon a tiny spherical cavity appears in the center of the button, when the latter is from 3 to 4 mm. in diameter. This increases in size with the growth of the button and the fleshy tissue increases in thickness up to about 3 mm. Until the sporophore is about 12–20 mm. in diameter, the tissue is about the same

thickness above and below the cavity, but at this stage when the hymenium begins to form in the ceiling of the cavity, as it were, the portion above becomes thicker while the portion below (the volva) becomes thinner. Peck (3) says this portion above the pore-bearing layer is in two strata, an outer thicker one and an inner thin stratum. Just when these strata of the fundamental tissue are differentiated is not known. In these later stages an appendage appears inside of the volva and protruding from around the hymenophore. This has been figured by Peck (3) and is imperfectly shown in some of the sections in the accompanying plate. It is probable that this appendage is not a constant characteristic. In some specimens it does not extend wholly around the hymenophore but forms irregular, tuberculose projections. In other specimens it appears as a very low ridge encircling the pore-bearing layer. As the volva becomes thinner, it grows downward in the portion near the attachment of the sporophore. Here it becomes very thin and the ostiole of the volva is formed. This is always very close to the tree trunk.

Until nearly the time when the ostiole is formed, the whole sporophore is very fleshy and watery. Now it begins to shrink somewhat by the loss of water and the texture becomes soft-corky and still of a white color. The tubes become yellowish to almost cinnamon. The shrinking of the whole sporophore causes a cracking of the resinous crust, which often scales off. In the old sporophores this leaves the white surface glabrous, but often anastomosingly rimose. The development of the sporophore as observed from free-hand sections is illustrated by the series of median vertical sections on plate 159, while the mature sporophores with well-developed ostioles are shown on the same plate.

More detailed work on the development of this peculiar polypore should be done to determine the histological development and formation of (*a*) the primordium of the pore-cavity, (*b*) the primordium of the hymenium, (*c*) the thin interior stratum of the sporophore, of which the appendage mentioned above is the projecting edge, (*d*) the constancy of this projecting appendage, and (*e*) the ostiole of the volva.

Pure cultures of the fungus were made from the tissue of the young sporophores. Potato hard agar was used as a medium.

The mycelium grows abundantly in cultures, and in a period of four weeks conidiospores were formed. These varied from ellipsoid to pyriform in shape. They appear on short conidiophores from the clamp-connections which are abundant in the hyphae.

The first stages of sporophores were obtained in cultures. Small sticks of hemlock wood about one inch in diameter were cut so that they would stand erect in an Erlenmeyer flask. The borings of insects (to which reference is made later) were imitated by boring a small gimlet hole lengthwise following the pith

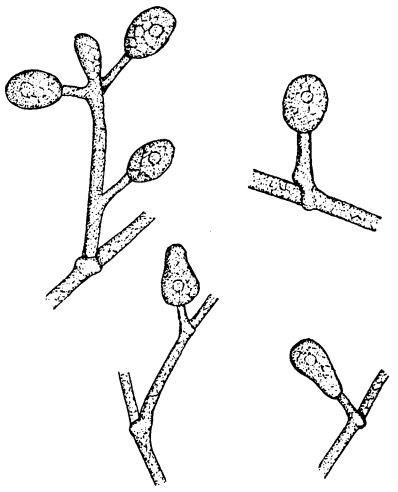

FIG. 1. Conidiospores formed in cultures of *Cryptoporus volvatus*.

of the stick. At right angles to this, other gimlet holes were bored, some near each end of the sticks. These sticks were put in flasks containing some agar and in such a way that some of the radial gimlet holes were just above the surface of the agar. After sterilization the agar was inoculated with *Cryptoporus* and the mycelium spread to the stick, entered the gimlet holes below, and emerged in the form of buttons above. These buttons grew in some cases to be 5–10 mm. in diameter but did not develop the internal cavity. The buttons formed in cultures were pure-white and without the ordinary coat of resin. The surface was perfectly even, dry, and glabrous.

The intimate relationship which exists between the attack of

timber by insects on the one hand and fungi on the other have been pointed out by several mycologists and entomologists. There are without doubt many fungi which follow the borings of insects. *Cryptoporus volvatus* is an example of this kind. It is found that a great many species of insects inhabit the pore-cavity. Hubbard (2) has dealt with the relation of insects to this fungus. The insects which wander in and out through the ostiole of the volva aid in the dissemination of the *Cryptoporus* spores. When the hymenium of the fungus begins to discharge spores the inside of the volva soon becomes covered with a heavy layer of spores and when the insects crawl in and out they take with them myriads of spores upon their bodies and appendages. Besides the large number of insects mentioned by Hubbard, the small fungus borer, *Sitodrepa panicea,* is found in nearly all of the mature sporophores and its borings in the tree extend quite a distance into the sapwood, where the insect would distribute the spores of the fungus.

This relationship of fungi and insects is surely significant in the dissemination of the spores of this fungus which has its fruiting surface so protected from other spore carriers, such as air currents, etc. However, it would be difficult to imagine that *Cryptoporus* is as dependent upon boring insects as suggested by House (1). He says that the volva aperture is the result of a boring weevil. This, however, is not consistent with the general appearance and development of the ostiole. During the stage of development when that portion of the volva had become thin and wholly vanished, with the exception of bits of the dead fundamental tissue, the writer has often cracked off the crust of resin from the under surface of the volva and thus disclosed a perfectly formed ostiole, through which no insect had ever passed. The margin of the ostiole is round and has the characteristic surface of the other portions of the fungus and very unlike the edge of a beetle boring. The ostiole of the volva of *Cryptoporus volvatus* is a morphological characteristic.

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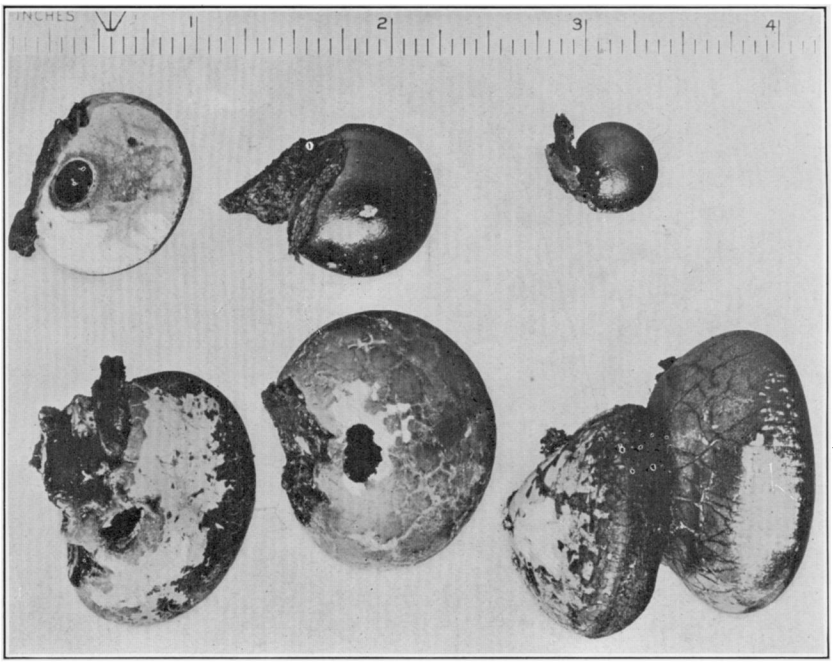

FIG. 1. SPOROPHORES OF CRYPTOPORUS VOLVATUS SHOWING OSTIOLE

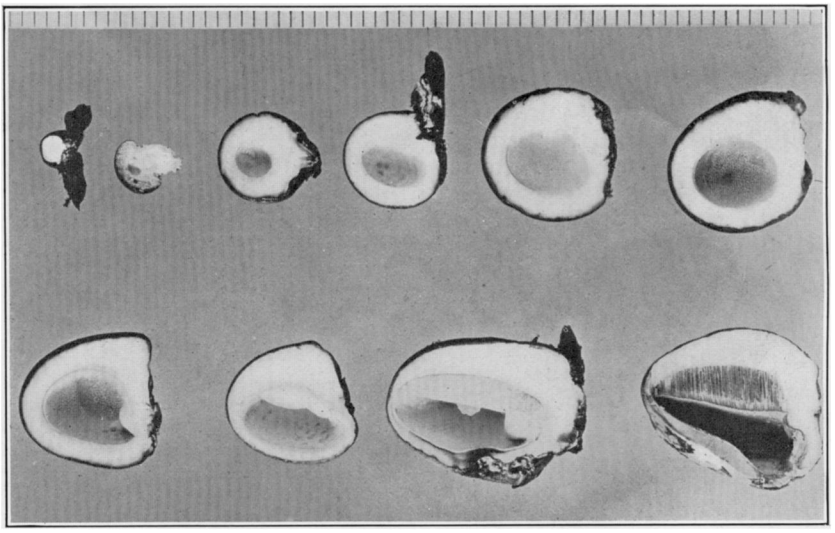

FIG. 2. SPOROPHORES OF CRYPTOPORUS VOLVATUS SECTIONED TO SHOW PORE-CAVITY

LITERATURE CITED

1. **House, H. D.** Origin of the volva aperture in *Cryptoporus volvatus* (Peck) Shear. Mycologia 6: 217–218. 1914.
2. **Hubbard, Henry G.** The inhabitants of a fungus. Canadian Entomologist 24: 250–255. 1892.
3. **Peck, C. H.** *Polyporus volvatus* Peck, and its varieties. Bull. Torrey Club 7: 102–105. 1880.

DESCRIPTION OF PLATE CLIX

FIG. 1. Sporophores of *Cryptoporus volvatus* (Peck) Shear. The two smallest ones show the resinous coating completely covering the surface. The ostiole of the volva has not appeared in this stage. Others show the resinous coat partially cracked from the surface exposing the white fungal tissue. Dead fundamental tissue is left adhering to the margin of the ostioles.

FIG. 2. Stages in the development of the sporophores, showing the enlargement of the pore-cavity, the gradual formation of the hymenophore and the ostioles of the volva.